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SPECIFICATION

~~[Electronic Version 1.2.8]~~

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[[[]]Stationary Armature Machine[[[]]]

Cross Reference to Related Applications

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3,870,914 03/1975 Walker, Alan 310/215 move text to next line →

4,573,001 02/1986 Lin, Banchien 318/695

Background of Invention

[0001] Conventional Brush Type DC Electric Motors have been used for many years in power tools, electric scooters & vehicles, appliances and other assorted machinery. The main parts are comprised of an armature, field structure, yoke or housing and brush rigging. The armature being the rotating part of the motor, consists of a laminated steel core having slots as a means for holding coils of wire electrically connected to a commutator affixed to a common shaft. Electrical current from a power source flows through stationary magnetic field coils and brushes affixed to a housing and through armature windings affixed to a rotor as a means for generating a rotating magnetic field magnetic wave that drives the rotor. This arrangement generates a large amount of heat at the center of the motor having limited means for heat abatement through the air gap, field structure and housing such that direct current brush type motors are much larger than ac motors (and BLDC) of the same power rating. The

armature and field structure of conventional brush type dc machines are connected electrically in series, shunt, compound and permanent magnet configurations.

Brushless dc (BLDC) motors having a rotating field and stator electrically connected to a multiphase electronic inverter as a means for electronic commutation inducing a rotating magnetic field that drives said rotor. BLDC motors having a stator affixed to said housing for increase thermal abatement operates more efficiently using dc power inverted into ac power by a multi-phase electronic inverter.

Summary of Invention

[0002] The Stationary Armature Machine (SAM) has a stationary armature similar to the BLDC motor, and a stationary commutator affixed to the frame or housing for increased heat abatement. The concept behind ~~my motor~~ SAM is simple: Reverse the physical position of the armature and field structure relative to the other by attaching the armature (and commutator) to the housing and the field structure (and brush assembly) to the shaft in a manner similar to BLDC motors. By making the armature (and commutator) stationary, the current carrying conductors can be made much larger as a means for increasing current carrying capacity at low voltages. Because ~~[[SAM"s]]~~ SAM's armature coils are stationary, they are unaffected by centrifugal forces generated by the ~~[[rotor"s]]~~ rotor's high rotating velocities. Heat generated by the armature is easily abated through the housing increasing its ability to transform electrical energy into mechanical energy efficiently. Hybrid vehicles and battery powered household /garden appliances are

becoming more assessable with the advent of high energy permanent magnets, lithium ion/NiMH battery technology and high power multiphase inverters.

Conventional DC brush type motors are unable to meet the demands of hybrid vehicles and appliances that required large amounts of power and operate at high rotating speeds such as leaf blowers and upright vacuum cleaners because of size, volume or weight constraints. Conventional low voltage high current dc motor armatures require large conductors that are subjected to tremendous centrifugal forces generated by the high rotating velocities. The rotating armature must be large enough to dissipate heat generated by high currents increasing the overall size relative to Brushless dc motors (BLDC) and Controlled Slip Induction motors (IM). BLDC and IM motors use a "stationary armature" (stator) that requires an external means of excitation such as a dc to ac multiphase (electronic) inverter at great expense. By comparison: (1) SAM does not require closedloop feedback for rotor positioning such as resolvers, encoders or hall-effect sensors; (2) Develops very high starting torque; (3) Low rotor Inductance and inertia when compared to conventional dc motors. SAM uses a unique brush cooling technique to reduce brush/commutator wear and uses a stationary armature as a means for increased power output, improved thermal abatement and reduced size similar to the BLDC motor. SAM, unlike BLDC and IM's uses a mechanical rotating brush and stationary commutator as a means for excitation instead of an external multiphase inverter increasing its cost effectiveness. Battery powered high output (1000 watts) upright vacuum cleaners and leaf blowers powered by SAM take advantage

of its stationary armature and large current carrying conductors to keep the overall size comparable to that of BLDC technology. Applications include: 1) Power tools & appliances (120 vac & dc battery powered)- up to 1500 watts; 2) Electric scooters & vehicles (battery powered) up to 200 Kilowatts; 3) Uninterruptible Power Supply (UPS) prime mover up to 2,000 Kilowatts; 4) Traction drives for heavy machinery up to 20,000 Kilowatts; 5) Power generators & motors up to 60,000 Kilowatts. ~~Motor- kilowatts and motor generator combination combinations~~ for use in hybrid vehicles up to 500 Kilowatts.

Detailed Description

[0003] Figure 1 shows the front view of a 2 pole rotating brush assembly as a means for conducting electric current from a power supply to the armature windings and field coils. Figure 1-1 shows the front view of the rotating brush assembly housing capable of providing physical support and electrical isolation of the attached components. Figure 1-2 shows a negative polarity copper brush holder attached to figure 1-1 as a means for guiding said brush and providing additional electric current shunting capacity. Figure 1-3 shows a positive polarity copper brush holder as a means for guiding said brush and providing additional electric current shunting capacity. Figure 1-4 shows a spring as a means for keeping said brush in contact with said commutator. Figure 1-5 shows the fulcrum of the brush keeper as a means for supporting said brush keeper and as means for providing a moment opposite that applied from centrifugal forces acting on

said brush. Figure 1-6 shows the counter weight portion of figure 1-12 as a means for applying a moment about said fulcrum equal an opposite to that applied by the figure 1-7 brush being forced outward by said centrifugal force. Figure 1-12 shows a conductive brush keeper and shunt as a means for keeping the brush in contact with the stationary commutator during high speed operation to counteract centrifugal forces acting on said brushes. Figures 1[[]]a and 1[[]]b show the bottom and top views of figure 1. Figures 1[[]]c shows a cutaway of fig 1. Figure 2 shows the front view of the stationary commutator, slip rings and rotating brush assembly. Figure 2-8 shows the base of the stationary commutator slip ring assembly as a means for support and electrical insulation between slip rings and commutator segments. Figure 2-9 shows commutator comprised of segments electrically insulated from each other and electrical connected to individual armature coils. Figures 2-10 & 11 shows the negative and positive polarity copper slip rings as a means for conducting current from a power source through said rotating brushes making contact with said stationary commutator as a means for generating a rotating magnetic field driving said rotor. Figures 2-13 & 14 show the negative and positive polarity power leads. Figure 3 shows the front view of a 4 pole variation of the 2 pole rotating brush assembly having brushes arranged 180 electrical degrees apart being physically arranged 90 degrees apart. Figure 4 shows the side view of the shunt wound stationary armature machine. Figure 4-15 shows the lead that connects the one armature coil to one commutator segment. Figure 4-16 shows the laminated steel armature core being affixed to the machine

housing and encompassing said rotor as a means for abating heat generated from copper losses within said armature. Figure 4-17 shows the armature windings placed inside slots within said core. Figure 4-18 shows the rotating electromagnetic field structure. Figure 4-20 shows the field structure winding: Figures 4-21 & 22 show the field structure leads as a means for conducting power from the brush holders to the rotating field structure winding. Figure 4a shows the front view of said motor. Figure 5 shows the side view of a series wound stationary armature machine. Figure 5-23 shows the lead of a copper brush holder and non-conductive brush keeper figure 5-24 being isolated from brush holder figure 5-25 as a means for conducting electric current through the rotating field and armature in a series electrical connection. Figure 5-24 shows a non-conductive brush keeper as a means for isolating the flow of electric current from a power source to the rotor coil via brush assembly figure 5-25 returning through brush assembly figure 5-23 continuing through said commutator assembly. Electric current flows through said armature to the opposite brush assembly having a shunt brush keeper continuing through the other stationary slip ring and out to the other terminal of said power source. Figure 6 shows the front view of the stationary commutator having a cylindrical shape and rotating brush assembly whereas the rotating brush assembly contacts the stationary commutator on the inside diameter of said commutator assembly. High speed rotation induces centrifugal forces that act to force said brushes against the inside diameter of the stationary commutator assembly. Figure 6a show a side view cutaway of figure 6.

Figure 7 shows the front view of the stationary commutator and rotating brush assembly having a rotating brush assembly comprised of two brushes permanently affixed a single copper shunt between the armature and slip rings as a means for conducting high electric current at low voltage and high rotating velocities.

Wherein figure 7-7 brush is attached to brush keeper shunts figures 7-2 & 3.

Figure 8 shows the front view of the radial stationary commutator and brush assembly, wherein the commutator and slip rings are arranged in a concentric pattern having a flat or conical surface as a means for increasing the cross sectional area through which electric current flows. Figure 8a shows the side view cutaway of figure 8. Centrifugal forces acting on the brushes generated by high speed rotation has little effect on the pressure at the point where the brushes make contact with the said commutator. Figure 9 shows the rotating brush assembly whereas brush keepers figures 9-2 & 3 and brushes figure 9-7 are permanently attached to each other. Centrifugal forces acting on the brushes generated by high speed rotation is counteracted by centrifugal force generated by a counter weight fig 9-6 limiting the pressure at the point where the brushes make contact with the said commutator. Figure 10 shows the side view of the permanent magnet variation of the stationary armature machine whereas the permanent magnet having characteristics similar to that of said shunt wound machines. Figure 11 shows the side view of the separately excited shunt wound stationary armature motor having a third regulating stationary slip ring figure 11 - 28 as a means for providing regulated current flow through lead figure 11-27 to

said field structure from an external regulator. Figure 11-26 shows a non-conductive brush keeper and copper brush holder isolated from the adjacent brush and holder as a means for conducting electric current from said regulating slip ring through lead figure 11-21 to said rotating field. Electric current continues to flow through said stationary commutator segment to the opposite rotating brush assemble. Said non-conductive brush keeper isolates the flow of electric current from said regulating source and said power source while the opposite rotating brush assembly having a shunt brush keeper such that the electric current flows from said rotating field coils and stationary armature in a shunt electrical connection flowing out to the other terminal of said power source completing the circuit. Figure 12 shows an electrical schematic representation of the stationary armature machine in said series wound connection wherein the same electric current from a power source flows through both the field coil and the armature such that torque is proportional to the square of the current. The series wound configuration is useful in applications that require high starting torque. Figure 13 shows an electrical schematic representation of the stationary armature machine in said shunt wound connection whereas the smaller part of the total electric current flows through the field coil which has a larger impedance and wherein the larger portion of the total current flows through the armature which has a much lower impedance such that torque is directly proportional to the current flowing through the armature. Said shunt wound configuration is useful in applications that require moderate torque and precise speed control. Figure 14 shows an

electrical schematic representation of the stationary armature machine whereas electric current flows through the stationary armature only. Said permanent magnet configuration is useful in applications that require bi-directional operation due to its ability to reverse the direction of rotation by reversing the polarity of the current flowing through the circuit. Figure 15 shows an electrical schematic representation of the stationary armature machine in said separately excited configuration wherein the electric current flowing through the field coil is regulated by means of an external exciter. The current circuit is completed through a shunt electrical connection between said stationary armature and rotating field coil. Said separately excited configuration is useful in applications that require high torque, precise speed control, induced voltage regulation and bi-directional operation.

Figures

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Claims

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[c 1 (Currently Amended)] I claim: The stationary armature variable speed self

commutating machine comprising: (a) a stationary armature including multiple sets of lap or wave windings connected in series forming multiple taps each attached to one commutator segment; (b) a rotor comprised of a coil or a permanent magnet as a means for inducing a steady state magnetic field encompassed by said stationary armature;

(c) a stationary commutating assembly comprised of multiple commutator segments each electrically insulated from the other being fixed to the machine housing, each said commutator segment being electrically connected to one of the said armature windings, having a pair of slip rings affixed to stationary machine housing and electrically insulated from each other, each slip ring being electrically connected to one end of said rotor coil, one slip ring being electrically connected to the terminal of an electrical current power source and the other slip ring being electrically connected to the other terminal of said power source, having a commutating means such that a rotating magnetic field is induced in said armature windings that drives the rotor; and (d) a rotating brush assembly being affixed to said rotor and comprised of a pair of brushes each electrically insulated from the other, having

springs, and a brush keeper with a counter weight at one end and a fulcrum at its center of gravity as means for applying pressure ensuring contact between said rotating brushes and stationary commutator segments, one of the said rotating brushes being physically arranged 180 electrical degrees apart from the other, each said brush having a limited range of movement within brush holder, electrically contacting one of the said slip rings and adjacent ones of said commutator segment forming an electrical shunt between them as a means for transferring electrical energy from a power source to said windings.

[c2 (Currently Amended)] The machine in claim 1 wherein said stationary armature windings and rotor coil having a shunt electrical connection such that electrical current from said power source flows through said armature windings and rotor coil in a parallel electrical connection.

[c3 (Currently Amended)] The machine in claim 1 wherein said stationary armature windings and rotor coil having a series electrical connection such that electric current from said power source flows through said armature windings and rotor coil in a series electrical connection.

[c4 (Currently Amended)] The machine in claim 1 wherein said stationary armature windings and rotor coil having a shunt electrical connection at one end via one of said rotating brushes such that electric current from said power source flows through said armature windings and rotor coil in a parallel electrical connection and whereas said current continues to flow from said rotor coil through a third

stationary slip ring affixed to the machine house continuing to an outside regulator as a means for separate excitation and regulation.

[c5 (Currently Amended)] The machine in claim 1 wherein said rotating brushes electrically contact the outer diameter of the cylindrical stationary commutator and slip rings such that centrifugal forces acting on said brushes forces them in an outward direction away from the surface of the commutating assembly parallel to the plane of rotation, while said brush keepers apply a moment equal and opposite that applied from the centrifugal forces acting on said brushes as a means for keeping said brushes in contact with said commutator assembly.

[c6 (Currently Amended)] The machine in claim 1 wherein said rotating brushes electrically contact the inner diameter of the cylindrical stationary commutator and slip rings such that centrifugal forces acting on said brushes forces them in an outward direction towards the inner surface of the commutating assembly parallel to the plane of rotation, while said brush keepers apply a moment equal and opposite that applied from the centrifugal forces acting on said brushes as a means for preventing said brushes from applying excessive pressure at the point of contact on said commutator assembly.

[c7 (Currently Amended)] The machine in claim 1 wherein said rotating brushes electrically contact the outer flat or conical surface of the stationary commutator and slip rings arranged in a concentric pattern such that centrifugal forces acting on said brushes forces them in an outward direction parallel to the plane of rotation and perpendicular to the point of contact between said commutator and brushes.

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Abstract of Disclosure

~~—[0004]—~~ The Stationary Armature Machine (SAM) is comprised a stationary armature ~~[[and]]~~ similar to Brushless DC ~~motor's~~ motor's stator, ~~[[and]]~~ a stationary commutator affixed to the frame or housing for increased heat abatement and a rotating field ~~[[and]]~~ with brushes affixed to a common shaft as a means for mechanical commutation. ~~[[SAM]]~~ SAM's unique stationary armature increases current carrying capacity and heat abatement at low voltages and high rotating ~~speed~~ speeds without increasing overall physical size relative to BLDC motors. ~~[[SAM's]]~~ SAM's armature and field structure are arranged in reverse having the armature in a stationary position with a commutation assembly affixed to the ~~machine's~~ machine's housing while said field structure (and brush assembly) rotate at the center of the machine. By making the armature and commutator assembly stationary, the current carrying conductors can be made much larger without being subjected to extreme centrifugal forces at high rotating velocities. SAM is ideally suited for applications that require lots of torque, power at high rotational speeds in a small inexpensive package.

~~—~~ Figures